## REMARKS

The Office Action dated June 22, 2004, has been carefully considered. Claims 1, 36, 68, 69, 74, 79, 98 and 99 have been amended. Claims 1-83, 98 and 99 are in this application.

Claim 1 has been amended to include a definition of surface pathways. Support for this amendment is found throughout the specification and in particular, on page 5, lines 29-30 of the application. Claim 1 has also been amended to define that flow of the fluid is by thermocapillary shear stresses of the liquid. Support for this amendment is found throughout the specification and in particular, on page 3, lines 5-15. No new matter has been entered.

The previously presented claims 1-83 were rejected under 35 U.S.C. § 103 as obvious in view of U.S. Patent No. 6,068,751 to Neukermans. Applicants submit that the teachings of this reference do not teach or suggest the invention defined by the present claims.

Neukermans discloses a microfluidic delivery system including a microfluidic valve for controlling a flow of fluid through an elongated capillary. The capillary is enclosed by a layer of malleable material. A blade is activated toward the malleable material to occlude the capillary and barring fluid from flowing in the capillary. The blade is retracted away from the malleable material to allow fluid to flow through the capillary. Pressure applied to a fluid reservoir urges liquid in the reservoir to flow along the capillary when the blade is in the retracted position. A reaction chamber coupled to the capillaries can be heated as required for a chemical process.

The Examiner stated that the heating of the liquid moves the fluid along the surfaces of the applied patent to Neukermans. Applicants submit that contrary to the Examiner's suggestion there is no movement of the fluid by heating in the Neukermans device. Rather, the method for enclosed fluidic control disclosed in Neukermans relies on reservoirs included in a pouch together with capillaries that supply fluids whose flow is controlled by movement of blades against a malleable surface. The blade action causes the malleable surface to occlude or introduce fluid into designated regions. The fluid is confined to an internal channel and the blade valves regulate the delivery and timing of liquid throughout a network. Accordingly, the liquid metering is strictly caused by the movement of the blades. The heating elements in Neukermans are only used to provide suitable reaction conditions. Thus, as Neukermans states in column 13, line 2+, by placing heaters above or beneath the pouch, the user can also heat a

liquid sample, say for initiating a chemical reaction. This heating, however, plays no role whatsoever in controlling the flow of liquid. Further, in contrast to the invention defined by the present claims, Neukermans does not teach or suggest a receiving liquid on a patterned surface comprising one or more surface pathways in which the surface pathways being either a flat topology with chemical patterning or an indentation, ridge or groove optionally having chemical patterning. To the contrary, Neukermans teaches interior flow of liquid within closed capillaries. Moreover, Neukermans teaches away from surface pathways by teaching the presence of a malleable material to enclose a surface of the capillaries. Accordingly, there is no teaching or suggestion in Neukermans of migration of fluid along surface pathways.

With regard to claims 70 and 71, Neukermans does not teach or suggest a method or device for dividing a stream of liquid including individually activating one or more heating elements. Accordingly, the invention defined by the present claims is not obvious in view of Neukermans.

With regard to claims 72 and 73, Neukermans does not teach or suggest a method or device for mixing two or more liquids including individually activating one or more heating elements.

Claims 98 and 99 were rejected as obvious in view of pages 353-355 of "Thermocapillary Pumping of Discrete Drop in Microfabricated Analysis Devices" by Sammarco et al.

Sammarco et al. teach enclosed fluidic control by heating one end of a liquid droplet via heaters embedded within a glass substrate. In order for this flow mechanism to work at all, the liquid droplet must be confined to an interior channel. As soon as the droplet is no longer completely enclosed within a channel (for example by removing either the top, bottom or one side wall), then the flow mechanism fails to work altogether.

The actuation mechanism is based on the concept illustrated by the diagram in attached Fig. 1. A small heater is activated below the gas-liquid interface at position 2. The higher temperature causes a drop in the liquid surface tension at position 2 ($\gamma_2$) which increases the pressure in the liquid behind the interface at position 2. Since the pressure in the liquid at position 2 is higher than the pressure at position 1 (i.e., $P_2 > P_1$), the liquid moves from position 2 toward position 1 (Arrow A1). The movement is strictly caused by this pressure differential

which acts perpendicularly to the gas-liquid interface (Arrows A2). Although the flow is caused by the application of heat, the flow mechanism and the formulae specifying the variables which control the flow speed are completely different than those for the invention defined by the present claims.

The present invention uses open fluid control by a combination of substrate chemical patterning (for definition of flow pathways) with embedded heaters for generating thermocapillary shear flow. Applicants note that thermocapillary shear flow is only viable at a gas-liquid or liquid-liquid boundary. The mechanism for flow control fails completely if the liquid is forced to reside within an enclosed channel surrounded by solid boundaries, as described in Sammarco et al. or Neukermans.

The actuation mechanism of the present invention is based on the concept illustrated in the attached Fig. 2. The liquid droplet must maintain at least one interface that is open to a gas or liquid phase (not a solid substrate). A heater is activated beneath one end of a liquid droplet at position 2 ($\gamma_2$). The higher temperature causes a drop in the liquid surface tension at position 2 ($\gamma_2$). The graduated difference in surface tension between position 1 and position 2 generates a thermocapillary shear stress which is oriented parallel to the gas-liquid interface (Arrow A4). This tangential force pulls the liquid droplet toward the colder end (Arrow A5). The force causing movement is a shear force, which acts tangentially to the gas-liquid interface and is not a perpendicularly oriented force as shown above for Sammarco et al. Although the flow is caused by the application of heat, the flow mechanism and the formula specifying the variables which control the flow speed are completely different from those described in Sammarco et al. In summary, one having ordinary skill in the art would not be able to control the direction, speed and timing as described in the present application using the teachings of Sammarco et al.

Furthermore, Sammarco et al. do not teach or suggest receiving liquid on a patterned surface comprising one or more surface pathways being either a flat topology with chemical patterning or an indentation, ridge or groove optionally having chemical patterning as defined by the present claims. In addition, Sammarco et al. do not teach or suggest storing the device in

glycerol as defined by present claims 98 and 99. Accordingly, the invention defined by claims 98 and 99 is not obvious in view of Sammarco et al.

In view of the foregoing, Applicants submit that all pending claims are in condition for allowance and request that all claims be allowed. The Examiner is invited to contact the undersigned should he believe that this would expedite prosecution of this application. It is believed that no fee is required. The Commissioner is authorized to charge any deficiency or credit any overpayment to Deposit Account No. 13-2165.

Respectfully submitted,

Dated: September 24, 2004

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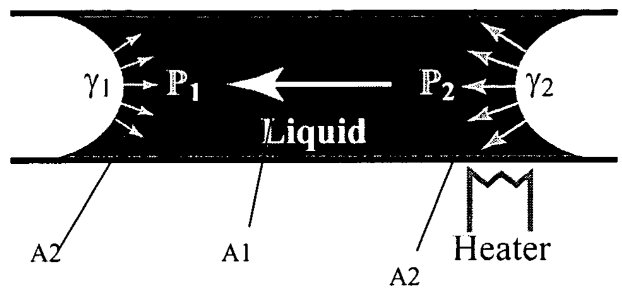


Fig. 1

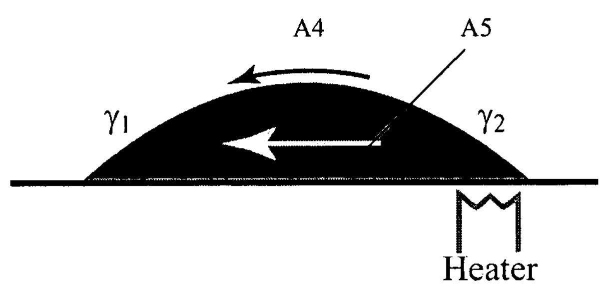


Fig. 2